

Focus on: Treatment by Carbon Adsorption

The regulations require that sites treating dangerous waste [obtain a permit](#).¹ However, Ecology allows generators to conduct certain types of waste treatment in accumulation tanks and containers.

This focus sheet explains how to treat your waste through on-site carbon adsorption. You don't need a permit or written approval to treat waste through carbon adsorption if you comply with this guidance and our [Focus on: Treatment by Generator publication](#),² however you must notify us using the [Site Identification form](#).³

Ecology may require your site to stop treatment activities if the process poses a threat to public health or the environment. For more details about treatment by generator, see the generator requirements⁵ in the Dangerous Waste Regulations.

If the treatment is part of an on-site wastewater treatment operation regulated under [permit by rule](#)⁶ or the waste is being treated to meet land disposal restriction standards,⁷ then you must comply with all other applicable federal, state, and local regulations.

What is carbon adsorption?

Adsorption is when molecular attraction forces bind liquid and gaseous chemicals to a solid surface. During treatment, contaminants adhere and accumulate to solid surfaces but don't chemically alter them.

Carbon used for adsorption is usually activated to make it very porous.⁸ Activated carbon has a large surface area that can adsorb large quantities of material per unit weight of carbon. Activated carbon is "spent" once it can no longer adsorb the target contaminant.

Two types of activated carbon are:

- Powdered activated carbon (PAC).
- Granular activated carbon (GAC).

Related information

- [Dangerous waste treatment by generator webpage](#)⁴
- [Focus on: Treatment by Generator](#)²

¹ <https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Dangerous-waste-permits>

² <https://apps.ecology.wa.gov/publications/summarypages/2004017.html>

³ <https://apps.ecology.wa.gov/publications/SummaryPages/ECY070133.html>

⁴ <https://ecology.wa.gov/DW-treatment-by-generator>

⁵ <https://app.leg.wa.gov/WAC/default.aspx?cite=173-303-170>

⁶ <https://apps.ecology.wa.gov/publications/SummaryPages/2104014.html>

⁷ See 40 CFR 268 and WAC 173-303-140 for land disposal restriction standards.

⁸ Carbon in certain configurations may also function as a filter. See our Focus on: Treatment by Filtration publication:

<https://apps.ecology.wa.gov/publications/SummaryPages/2304048.html>

PAC is added to industrial wastewater sludge systems to adsorb contaminants. In some cases, PAC biodegrades compounds as a secondary effect. Spent PAC, which typically forms a mixed sludge, is difficult to regenerate and usually must be disposed.

GAC is generally placed in vessels that form a filter bed. A GAC bed treats vapor, liquid, or aqueous mixtures by passing them through the bed. GAC can generally be regenerated and used again.

Carbon adsorption processes can produce three wastes depending on the treated influent media type:

- Treated effluent.
- Backwash effluent (backwashing disengages solids trapped in a filter bed).
- Spent carbon residual.

When is this treatment effective?

Carbon adsorption can effectively be used as a standalone treatment or part of a treatment train. You may use carbon adsorption to remove toxic constituents such as metals, organic solvents, and organic and inorganic compounds from waste streams (see the [example below](#)).

Please note: There are several factors that determine the carbon treatment's efficiency and applicability. Your carbon supplier can provide a more accurate estimate of your waste stream's carbon adsorption capacity.

Organic compounds

These compounds are readily adsorbable:

- Aromatic solvents (benzene, toluene, and nitrobenzenes)
- Chlorinated aromatics (PCBs,⁹ chlorobenzenes, and chloronaphthalene)
- Chlorinated nonaromatics (carbon tetrachloride, chloroalkyl ethers, and hexachlorobutadiene)
- Chlorinated solvents (trichloroethylene and tetrachloroethylene)
- High-molecular weight hydrocarbons (dyes, gasoline, amines, and humics)
- Phenol and chlorophenols
- Polynuclear aromatics (acenaphthene and benzopyrenes)
- Pesticides and herbicides (DDT,¹⁰ aldrin, chlordane, BHCs,¹¹ and heptachlor)

These types of compounds are poorly adsorbable:

- Acids and aldehydes
- Alcohols
- Low molecular weight aliphatics
- Low molecular weight ketones
- Sugars and starches
- Very high molecular weight or colloidal organics



Photo credit: [Carbonair Environmental Services Inc](#)¹²

⁹ PCBs: Polychlorinated biphenyls

¹⁰ DDT: Dichlorodiphenyltrichloroethane

¹¹ BHCs: Benzene hexachlorides

¹² <https://www.flickr.com/photos/carbonair/6964127640>

Inorganic compounds

These compounds have high adsorption potential:

- Bromine
- Chlorine
- Fluoride
- Iodine

These compounds have low adsorption potential:

- Bromide
- Chloride
- Iodide
- Nitrate
- Phosphate

Metals

These metals have high adsorption potential:

- Antimony
- Arsenic
- Bismuth
- Chromium
- Tin

These metals have good adsorption potential:

- Cobalt
- Mercury
- Silver
- Zirconium

These metals have fair or low adsorption potential:

- Barium
- Cadmium
- Copper
- Iron
- Lead
- Manganese
- Molybdenum
- Nickel
- Radium
- Selenium
- Titanium
- Tungsten
- Vanadium
- Zinc

What are the requirements?

You may treat your waste by carbon adsorption if:

- You follow appropriate state or federal regulations when managing your treated effluent and backwash.
- You either:
 - Regenerate spent carbon in a safe manner without discharging hazardous waste to the air, land, and water.
 - Designate and handle spent carbon as hazardous or non-hazardous waste as appropriate.
- You prevent spills and releases. If they occur, you clean them up immediately and [report any spill](#)¹³ that poses a threat to human health or the environment, regardless of size.
- You decontaminate all equipment as needed.

As you design your carbon adsorption system, you must consider the carbon's ability to adsorb contaminants from a particular waste stream. The contaminants must be adsorbed in the shortest amount of contact time possible.

¹³ <https://apps.ecology.wa.gov/publications/SummaryPages/2004036.html>

What's an example?

A generator has a container of chromium-contaminated rinsewater. They add activated carbon to the waste and, after thorough mixing, it has settled. The generator uses the water for the rinsing operation and either regenerates the carbon or designates it and sends it for proper disposal.

Where can I learn more?

For more information, please contact a dangerous waste specialist in your region's office.



Southwest Regional Office: 360-407-6300

Counties: Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Mason, Lewis, Pacific, Pierce, Skamania, Thurston, Wahkiakum

Northwest Regional Office: 206-594-0000

Counties: Island, King, Kitsap, San Juan, Skagit, Snohomish, Whatcom

Industrial Section: 360-407-6916

Central Regional Office: 509-575-2490

Counties: Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima

Eastern Regional Office: 509-329-3400

Counties: Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman

Nuclear Waste Program: 509-372-7950

ADA Accessibility

To request an ADA accommodation, contact Ecology by phone at 360-407-6700 or email at hwtrpubs@ecy.wa.gov, or visit ecology.wa.gov/accessibility. For Relay Service or TTY call 711 or 877-833-6341.